General Certificate of Education
Advanced Level Examination
June 2014

Biology BIO6T/P14/task

Unit 6T A2 Investigative Skills Assignment
Task Sheet

Investigating reaction times

Introduction

In this investigation, you will determine whether reaction time is affected by a brief exposure to a cold temperature.

Your teacher will tell you how many people you will use. If you investigate the reactions of fewer than five people, your teacher will give you additional data to use during your analysis.

Materials

You are provided with the following:

- access to at least two people
- measuring stick, such as a metre ruler
- ruler to allow you to measure the gap between each person's finger and thumb
- water bath for ice-water
- access to water
- supply of ice
- thermometer
- timer (or sight of classroom clock or your own watch)
- paper towels.

You may ask your teacher for any other apparatus you require.

Method

Read these instructions carefully before you start your investigation.

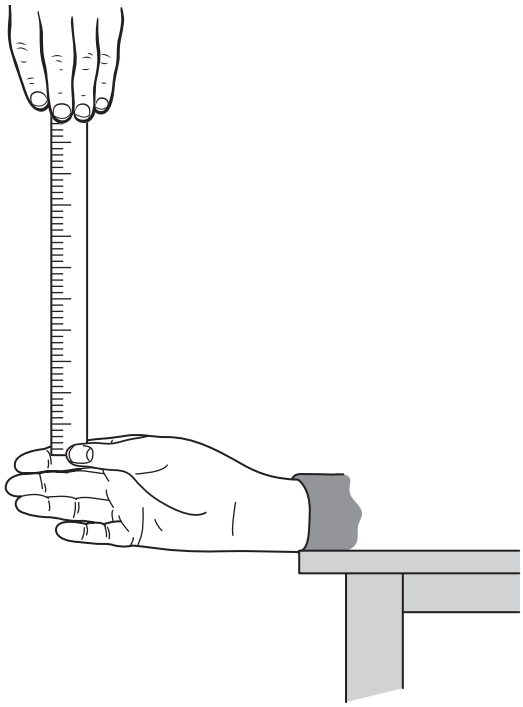
Reaction before exposure to cold

1. Sit the first person (Person 1) by a table or bench with the arm of their choice resting on the work surface. Tell the person to keep the arm on the work surface but to adjust its position so that the wrist and hand overhang the edge.

2. Ask the person to open their chosen hand and use the ruler to ensure they have a gap of 7 cm between the index finger and thumb.

3. Hold the measuring stick vertically, as shown in **Figure 1**, above the person's hand so that the starting point or zero on the scale is between their thumb and index finger and without the person touching it.

Figure 1



4. Read the following instructions to the person.

   "I will drop the stick without warning. When I drop the stick, you must catch it as quickly as you can between your thumb and index finger."

5. Let the stick drop sometime within a 5-second period after you finish reading the instructions.

6. Measure the distance the stick has fallen, in centimetres, by reading the value where the stick is held by the person (or mark this point and place the stick by a ruler or tape measure so that you can determine the distance it has fallen). Record this as Trial 1 in **Table 1** on page 4.

7. Repeat steps 2 to 6 twice with Person 1 but, during step 5, vary the time when you release the stick within the 5-second period. Record these as Trial 2 and Trial 3 in **Table 1** on page 4.

Reaction after exposure to cold

8. Set up an ice-water bath by adding ice cubes to cold water. The depth of water must be sufficient for a hand to be submerged without overflowing. Keep the ice-water at a temperature of about 5 °C.

9. Ask the person to place the same hand they used in step 1 into the water bath. Make sure their hand is fully submerged and then time 1 minute.

10. After 1 minute, tell the person to remove their hand from the water bath, dry it and resume the position of their arm on the work surface.

11. Repeat steps 2 to 7 as quickly as possible.

12. Repeat steps 1 to 11 with the second person (Person 2).

13. Your teacher will either tell you to repeat steps 1 to 11 with more people or provide you with further sets of data.

You will now have results for five people. You may assume that this will give you sufficient data for a statistical test.

You will need to decide for yourself:

- when you will drop the measuring stick
- the point on the measuring stick where it is caught by the person
- how you will maintain a suitable temperature in the water bath.

Do not write outside the box

ISA BIO6T/P14 Candidate Results Sheet: Stage 1

Investigating reaction times

Centre Number | | | | | | Candidate Number | | | | |

Candidate Name.....

Record all your data in **Table 1**. In column 3, indicate whether the data are your own (**O**) or were given to you by your teacher (**T**).

Table 1 Distances measuring stick fell before it was caught

Condition	Person	O or T	Distance measuring stick fell before it was caught / cm		
			Trial 1	Trial 2	Trial 3
Before exposure to cold	**1**	O			
	2	O			
	3				
	4				
	5				
After exposure to cold	**1**	O			
	2	O			
	3				
	4				
	5				

There are no marks awarded for the table at A2.

Do not write outside the box

In this investigation, reaction time is how long it takes to catch the measuring stick after it is released. You can calculate this length of time from the distance that the measuring stick fell and by taking into account the effect of gravity.

1 Complete **Table 2**. Use only your **Trial 3** values from **Table 1** and the following formula to calculate the reaction time, to 3 decimal places, for each person, before and after exposure to cold.

[1 mark]

$$t = \sqrt{\frac{2d}{980}}$$

where t = time in seconds
d = distance measuring stick fell in centimetres

Space for calculations

Table 2 Reaction time of person before and after exposure to cold

Person	Reaction time / s	
	Before exposure to cold	After exposure to cold
1		
2		
3		
4		
5		

Hand in this sheet at the end of each practical session.

1

End of Stage 1

Do not write outside the box

ISA BIO6T/P14 Candidate Results Sheet: Stage 2

Investigating reaction times

Centre Number | | | | | | Candidate Number | | | | |

Candidate Name .....

For your statistical analysis, use:

- your calculations of reaction times of five people before and after exposure to cold (**Table 2**).

Use a statistical test to analyse your data. You may use a calculator and the AQA Students' Statistics Sheet that has been provided.

A sheet of graph paper is supplied. You may use this if you wish.

2 State your null hypothesis.

[1 mark]

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3 (a) Give your choice of statistical test.

[1 mark]

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3 (b) Give the reason for your choice of statistical test.

[1 mark]

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Do not write outside the box

4 Carry out the test and calculate the test statistic. Show your working.

[1 mark]

5 Interpret the test statistic in relation to your null hypothesis being tested. Use the words **probability** and **chance** in your answer.

[2 marks]

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END OF QUESTIONS

6

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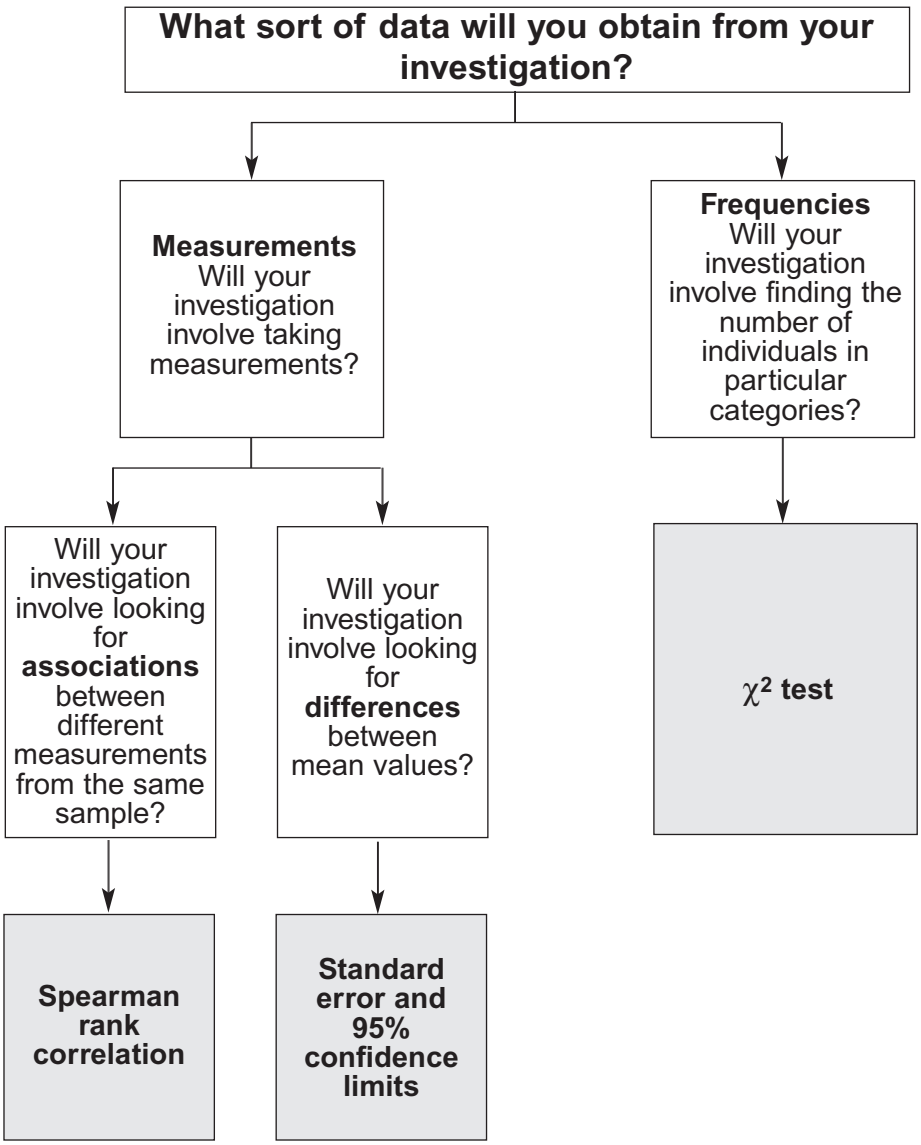
AQA Students' Statistics Sheet (version 3)



Standard error and 95% confidence limits

Calculate the standard error of the mean, SE, for each sample from the following formula

$$SE = \frac{SD}{\sqrt{n}}$$

where SD = the standard deviation
and n = sample size

95% confidence limits = $2 \times SE$ above and below the mean

The χ^2 test

The chi-square (χ^2) test is based on calculating the value of χ^2 from the equation

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

where O represents the results you observe in the investigation
and E represents the results you expect.

Table showing the critical values of χ^2 at P = 0.05 for different degrees of freedom

Degrees of freedom	Critical value
1	3.84
2	5.99
3	7.82
4	9.49
5	11.07
6	12.59
7	14.07
8	15.51
9	16.92
10	18.31

Spearman rank correlation test

Calculate the value of the Spearman rank correlation, r_s, from the equation

$$r_s = 1 - \left[\frac{6 \times \Sigma D^2}{n^3 - n}\right]$$

where n is the number of pairs of items in the sample and D is the difference between each pair of ranked measurements.

Table showing the critical values of r_s at P = 0.05 for different numbers of paired values

Number of pairs of measurements	Critical value
5	1.00
6	0.89
7	0.79
8	0.74
9	0.68
10	0.65
12	0.59
14	0.54
16	0.51
18	0.48

For use in the ISA and EMPA assessment

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